

application of this threshold value to the accessible LUNs in table 122 results in displaying only those LUNs whose capacities exceed this threshold.

*Event Processing*

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Referring to the discussion in connection with FIGURE 6, the SAN manager 20 includes one or more fiber channel (FC) discover engines (or other such engines corresponding to the interconnect 16 and/or host-to-storage device communication protocol), such as the discover engine 40 responsible for gathering topology and attribute information for the SAN components.

10 Each discover engine 40 receives and processes information gathered by one or more scanners, such as scanner 42, which are executables that interact with the hosts 12 by performing system calls and IOCTL calls to gather information. The SAN Manager 20 includes a query engine 46 that is a helper service which manages inband and outband scan requests. The discover engine 40, registers scan requests with the Query Engine 46 which specifies target, scanner name and 15 period of execution information. The query engine 46 coordinates running of the scanners and returning information to the client. A portion of the query engine 46 includes outband scanners which perform Simple Topology and Topology scans.

The function of gathering information is split among several scanners, e.g., an attribute scanner, 20 topology scanner, a simple topology scanner and an outband topology scanner. Together, these collect inband and outband information including host and device interconnectivity (e.g., which storage devices are accessible to which hosts and host file system utilization), host attributes (e.g., file system information, including identities of mounted storage devices), storage device

attributes (e.g., storage capacities), and interconnect element information. The scanners can perform information gathering, or discovery, on boot-up of the hosts and periodically thereafter, e.g., at a preset interval set by the system administrator or by default. They can also perform discovery on occurrence of events detected by their respective hosts, e.g., resulting from insertion or removal of a storage device, or at the request of the SAN manager 20. In the illustrated embodiment, complete scans are transmitted by the scanners 42 to the discover engine 40. That information is transmitted in XML format over via a TCP/IP connection, e.g., via network connection 18. In alternate embodiments, communications can be in other formats and/or via alternate network or other communication connections.

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Discover engine 40 maintains a one level-deep history of scans from each scanner 42. It discerns changes in the SAN by comparing each scan as it is received from each respective scanner with a prior scan from that same scanner. If the engine 40 identifies differences affecting the topology of the SAN, it generates and forwards to the SAN manager 20 service module 38 notifications reflecting those changes. These can include, for example, notifications indicating addition of a new host or storage device, modification of attributes of a host or storage device, removal of a device, or change or removal of a relationship between a host and a storage device. In one embodiment of the invention, the discover engine 40 generates a single notification for each change identified when comparing a newly received scan with a prior scan from the same scanner 42. In alternate embodiments, it can forward multiple notifications and/or data for each identified change.

In the illustrated embodiment, when all the notifications resulting from comparison of a newly received scan with a prior scan from the same scanner 42 are completed (i.e., transmitted to the service module 38), the discover engine generates a further notification. This "scan complete" notification (or other termination notification) signals the service module 38 that the prior 5 notifications just generated pertain to a single scan. In alternate embodiments, e.g., where the discover engine generates multiple notification and/or data for each identified change, the engine 40 can generate a "scan complete" or another such termination message following generation of those multiple notifications/data.

10 Due to the nature of the SAN 10, scans are typically generated by the scanners 42 asynchronously with respect to one another. Moreover, scans conducted following processing by the service module 38 of the topology changes identified by the discover engine 40 can result in generation of further notification. To avoid an excessive backlog of notifications, the module 38 queues the received notifications in groups. It processes the groups only after receiving the scan 15 complete or other termination notification for that group. Moreover, it processes each group of notifications one at a time and atomically. To accomplish this, processing is effected through execution of tasks created for handling each respective group of notification and placed on a *separate* queue by the service manager 38.

20 The SAN service module 38 places on a first queue Q1 notifications N1, N2, N3, . . . received from the discover engine during processing of a newly received scan. Upon receiving a scan complete notification for that scan, the service manager creates a task S1 for (i) processing the notifications N1, N2, N3, . . . , and (ii) updating the manager 20 representation of the SAN